

We claim:

1. An optical fiber amplifier, comprising:

a length of silica optical fiber having a core doped with neodymium, a first cladding and a second cladding each with succeeding lower refractive indices, wherein said first cladding diameter is less than 10 times the diameter of said core, wherein the doping level of said neodymium within said optical fiber is chosen so that the small signal absorption for 816 nm light traveling within the core is less than 15 dB/m.

means for providing an optical signal having a wavelength within the range from 930 nm to 950 nm;

means for providing pump light having a wavelength within the range of 800 nm to 830 nm;

means for optically coupling said optical signal into said core; and

means for optically coupling said pump light into said first cladding of  
said optical fiber, wherein said optical signal is amplified to produce an  
15 amplified signal.

2. The amplifier of claim 1, further comprising means for coupling  
said amplified signal out of said optical fiber.

3. The amplifier of claim 1, wherein said neodymium is co-doped with  
germanium, but not phosphorous or aluminum.

4. The amplifier of claim 1, further comprising a first mandrel around  
which said optical fiber is wrapped, wherein said mandrel comprises a radius  $R$ ,  
wherein  $R$  is chosen to provide more than 10 dB of total bend induced loss of  
1088 nm light propagating in said core and less than 1 dB of total bend induced  
5 loss of 930 nm-950 nm light propagating in said core.

5. The amplifier of claim 4, further comprising a second mandrel  
around which said optical fiber is further wrapped, wherein about one-half of  
the length of said optical fiber is wrapped around said first mandrel and about  
one-half of said optical fiber is wrapped around said second mandrel, wherein  
5 said second mandrel comprises a radius  $R$ , wherein  $R$  is chosen to provide more

than 10 dB of total bend induced loss of 1088 nm light propagating in said core and less than 1 dB of total bend induced loss of 930 nm-950 nm light propagating in said core.

6. The optical amplifier of claim 1, wherein said optical fiber comprises end faces that are angle cleaved to prevent back-reflections.

7. The optical fiber amplifier of claim 1, further comprising at least one filter operatively placed with respect to said optical fiber to provide optical loss at wavelengths greater than 1000 nm, but little to no loss at wavelengths shorter than 1000 nm.

8. The optical fiber amplifier of claim 1, wherein said core is approximately 30 microns in diameter, has a numerical aperture of 0.06 and a small signal absorption due to the Nd ions of 5-10 dB/m at 810 nm, wherein said first cladding comprises a diameter of 125 microns and a numerical aperture of greater than 0.4.

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9. The optical fiber amplifier of claims 1, wherein said core is approximately 20 microns in diameter, has a numerical aperture of 0.06 and a small signal absorption due to the Nd ions of 8-12 dB/m at 810 nm, wherein said

5 first cladding has a diameter of 125 microns and a numerical aperture of greater than 0.4.

10. The optical fiber amplifier of claims 1, wherein said optical fiber does not have circular symmetry because said symmetry is broken by the creation of one or more flat surfaces on the outer diameter of said first cladding.

11. The optical fiber amplifier of claim 1, further comprising a cascaded series of identical optical amplifiers identical to said optical fiber.

12. The optical fiber amplifier of claim 1, further comprising:  
means for providing optical feedback to said amplifier; and  
means for coupling light out of said amplifier.

13. The optical fiber amplifier of claim 1, wherein the signal light has a total optical bandwidth of less than 5 GHz.

14. The optical fiber amplifier of claim 1, further comprising means for cooling said optical fiber to a temperature of less than 200 K.

15. The optical fiber amplifier of claim 1, further comprising means for cooling said optical fiber to a temperature of less than 100K.

16. The optical fiber amplifier of claim 1, wherein said core comprises Nd/Ge/Si, wherein said optical fiber comprises a core to cladding diameter ratio of 1:4, wherein said core has a NA that is less than 0.1 and a cladding NA that is >0.3, wherein the Nd<sup>3+</sup> concentration gives an absorption of less than 15 dB/m at 816 nm above the fiber background loss, said amplifier comprising a high reflector at one end of said fiber and an output coupling mirror at the opposite end.

17. The optical fiber amplifier of claim 1, wherein said first cladding comprises a diameter in the range from 100 microns to 2 mm.

18. The optical amplifier of claim 1, wherein said 930 nm to 950 nm signal is pulsed light.

19. A method for amplifying light, comprising:  
providing a length of silica optical fiber having a core doped with neodymium, a first cladding and a second cladding each with succeeding lower refractive indices, wherein said first cladding diameter is less than 10 times the

5        diameter of said core, wherein the doping level of said neodymium within said optical fiber is chosen so that the small signal absorption for 816 nm light traveling within the core is less than 15 dB/m.

             a step for providing an optical signal having a wavelength within the range from 930 nm to 950 nm;

10                a step for providing pump light having a wavelength within the range of 800 nm to 830 nm;

             a step for optically coupling said optical signal into said core; and

             a step for optically coupling said pump light into said first cladding of said optical fiber, wherein said optical signal is amplified to produce an  
15        amplified signal.

             20. The method of claim 19, further comprising a step for coupling said amplified signal out of said optical fiber.